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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|---------------------|------------------|
| 10/617,767 | 07/14/2003 | Jung-Hyun Lee | 249/349 | 4046 |
| 7590 | 03/18/2004 | | EXAMINER | |
| LEE & STERBA, P.C. Suite 2000 1101 Wilson Boulevard Arlington, VA 22209 | | | | VOCKRODT, JEFF B |
| | | ART UNIT | | PAPER NUMBER |
| | | 2822 | | |

DATE MAILED: 03/18/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|------------------------|---------------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 10/617,767 | LEE ET AL. | |
| | Examiner | Art Unit | |
| | Jeff Vockrodt | 2822 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 10 November 2003.
 2a) This action is FINAL. 2b) This action is non-final.
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-15 is/are pending in the application.
 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
 5) Claim(s) _____ is/are allowed.
 6) Claim(s) 1-15 is/are rejected.
 7) Claim(s) _____ is/are objected to.
 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ . |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____ . | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| | 6) <input type="checkbox"/> Other: _____ . |

DETAILED ACTION

This office action is in response to the preliminary amendment filed on 11-10-03. Claims 1-15 are pending.

Claim Rejections - 35 USC § 112

The following are quotations from the first and second paragraphs of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 2-4, 7, and 10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 2 states, "The method of claim 1, wherein each of the oxidation barrier layers is formed of a layer of a material selected from the group consisting of groups III, IV, and V metal electrodes and oxides thereof." (my emphasis.) First off, it is not clear what is being claimed-- barrier layers that are made of certain metals and metal oxides or electrodes? The reference to "electrodes" does not fit into the claim since the oxidation barrier is not an "electrode." How can the barrier be selected from a group of electrodes if it is not itself an electrode? Claim 2 is indefinite. Claim 3 limits the "metal electrodes" to Al, Ta, Ti, Hf, and Zr, however, only aluminum (group III) is within group III, IV, and V compounds. Claim 3 limits the "metal oxide" (i.e., barrier layer) to oxides of Al, Ta, Ti, Hf, and Zr, of which only Al is a group III metal. Claims 3 and 4 incorporate the limitations from claim 2, raising an additional internal inconsistency in these claims which renders the scope of the claims unreasonably vague. Claims 2 and 3 are indefinite.

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The range of claim 5 "between about tens to hundreds of Å" is indefinite. Does 10Å come within the lower bound of "about tens" of Å? How about 9Å, 900Å, or 1000Å? Even 2200Å can be viewed as twenty-two hundred Å (hundreds), but it is also within the realm of thousands. Nothing in the specification makes the scope of these ranges clear as they appear verbatim in the specification without further elaboration (¶ 0013). Claim 5 is indefinite.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

- (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
- (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
- (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-2, 4-7, 9, 13-15 are rejected under 35 U.S.C. 102(a,e) as being anticipated by US 6,407,435 ("Ma").

Ma discloses a method of making a dielectric stack by sequentially depositing barrier layers (preferably Al₂O₃) and high-k layers (preferably ZrO₂, but also BST) over a substrate to form a multilayer stack (col. 4, ll. 26-45; steps 520, 530, Fig. 9) followed by annealing the stack (step 550, Fig. 9) and depositing an electrode (step 560, Fig. 9).

Claims 2 and 4 appear to be met by the use of Al₂O₃.

Claims 5-6 appear to be met by layers of 50Å (col. 4, ll. 26-46). Claim 6 requires "wherein the thickness of each of the oxidation barriers is adjustable." This "adjustable"

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language does not impose any restrictions on the method steps that are claimed, but seems to be a statement that the method can be performed using different thickness. Ma clearly teaches that this is the case (col. 5, last ¶).

Claims 7 and 9. Ma teaches a thermal oxidation step to condition the layer or interface. Given the similar materials and process conditions, it is more likely than not that some diffusion (even if only a small amount) inherently takes place in the process of Ma.

Claims 13-14. Ma teaches both CVD and ALD (col. 6, ll. 36-39). ALD or "pulsed CVD" is a specific instance of CVD.

Claim 15. BST can be used as the dielectric.

Claims 1-2, 4-7, 9, and 13-14 are rejected under 35 U.S.C. 102(b) as being anticipated by US 5,688,724 ("Yoon").

Yoon teaches a method of making a dielectric structure comprising the steps of depositing a first dielectric layer (32) on a substrate (30, Fig. 14); depositing a second dielectric layer (34) on the first dielectric layer (32), depositing a third dielectric layer (36) on the second dielectric layer (34) depositing a fourth dielectric layer (38) on the third dielectric layer (36), depositing a fifth dielectric layer (40) on the fourth dielectric layer (38) to form a dielectric stack (90), and depositing an electrode (46) over the dielectric stack (90). The first, third, and fifth dielectric layers (32, 36, and 40) are secondary dielectrics which can be (silicon oxide, silicon nitride, titanium dioxide, or aluminum oxide). The second and fourth dielectrics are primary dielectrics which have a high dielectric constant (tantalum pentoxide, aluminum oxide, titanium dioxide). The electrode can be made of tungsten or titanium nitride (col. 11, 18-30). Annealing is performed after depositing the dielectric layers (col. 8, ll. 43-44).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 10 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over

Ma.

Ma is discussed and applied above to claims 1-2, 4-7, 9, 13-15. Ma teaches an annealing step using a temperature of between 400 to 900°C, which overlaps the claimed range of lower than about 700°C. Temperature is a results effective variable. Substantial overlap of a claim range in the absence of evidence of criticality or unexpected results gives rise to a prima facie case of obviousness.

Claims 10 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoon.

Yoon is discussed and applied to claims 1-2, 4-7, 9, and 13-14 above. Yoon teaches an annealing step using a temperature of between 600 to 1000 °C, which overlaps the claimed range of lower than about 700 °C. Temperature is a results effective variable. Substantial overlap of a claim range in the absence of evidence of criticality or unexpected results gives rise to a prima facie case of obviousness.

Claims 3, 8, and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma in view of U.S. 6,320,213 ("Kirlin").

Ma teaches the dielectric stack discussed above, which is "useful as a dielectric for storage capacitors" (col. 7, ll. 34-38), but does not teach an electrode material.

Kirlin teaches a high dielectric storage capacitor that uses an aluminum metallization layer (col. 2, ll. 29-32).

It would have been obvious to one of ordinary skill in the art to use the an aluminum metallization layer (electrode) in combination with the dielectric stack of Ma since aluminum was a well known metal for use as a metallization layer in storage capacitors.

Claim 11. Ma teaches an annealing step using a temperature of between 400 to 900 C, which overlaps the claimed range of lower than about 700 C. Substantial overlap in the absence of evidence of criticality or unexpected results gives rise to a *prima facie* case of obviousness.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. These references appear to be cumulative to the references relied on above.

Marshall teaches a method of forming a laminar ceramic composite material comprising the steps of: forming a first oxidation barrier (aluminum oxide layer 11) on a substrate (lowermost layer 10); forming a plurality of dielectric layers (Ce-ZrO₂ layers 12, 14, 16) on the oxidation barrier (11); wherein one of a plurality (e.g., 13) of additional oxidation barrier layers is disposed between each of the plurality of dielectric layers (e.g., 12) and an adjacent dielectric layer (e.g. 14).

Haukka teaches a method of forming a dielectric stack in an integrated circuit comprising the steps of: forming a first oxidation barrier (aluminum oxide 114) on a substrate (conductors 116); forming a plurality of dielectric layers ("high-k" layers 112) on the oxidation barrier (114); wherein one of the plurality (113) of additionally oxidation barrier layers is disposed between each of the plurality of dielectric layers (112) and an adjacent dielectric layer (See Fig. 4).

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Claim 15. Both Ba titanate and Sr titanate are disclosed as exemplary "high-k" materials (col. 10, ll. 4-6).

Any inquiry concerning communications from the examiner should be directed to Jeff Vockrodt at (571) 272-1848. The examiner can be reached on weekdays from 9:30 am to 5:00 pm EST. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian, can be reached at (571) 272-1852.

The fax number for official correspondence is (703) 872-9306. Unofficial communications to the examiner may be faxed to (571) 273-1848. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist at (703) 308-0956.

March 7, 2004

J. Vockrodt



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